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1896

Land Cement Works
Karlstadt on Main
Late Ludwig Roth

Largest Cement Works in Bavaria

Annual Production
50,000 Tons of
Portland Cement

Export Agents. Tulloch & Co.

Cement Exporters,

4, Fenchurch Avenue, London, E.C.

August 1896

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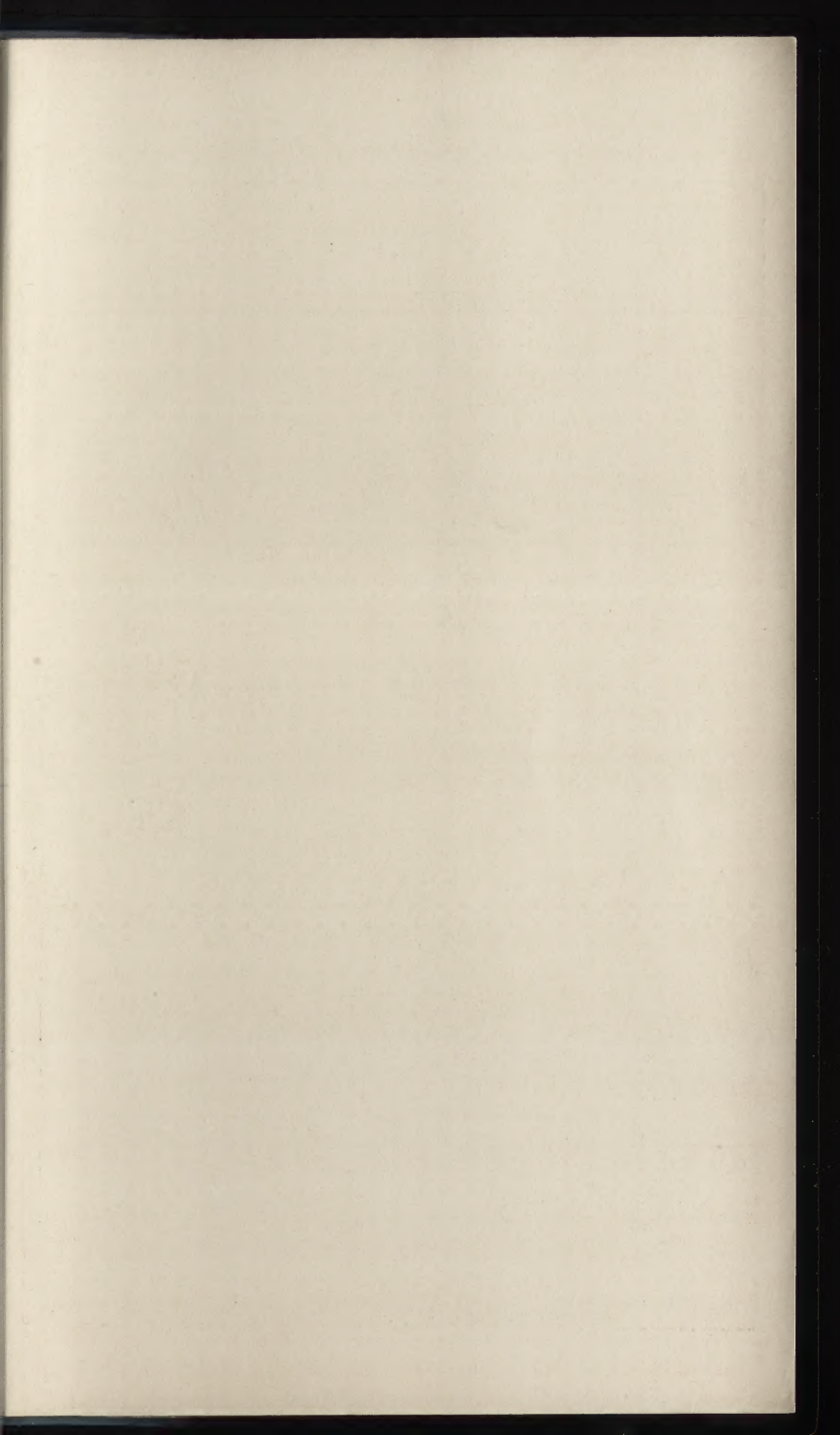
Given by *Mr. Morris Ebert*

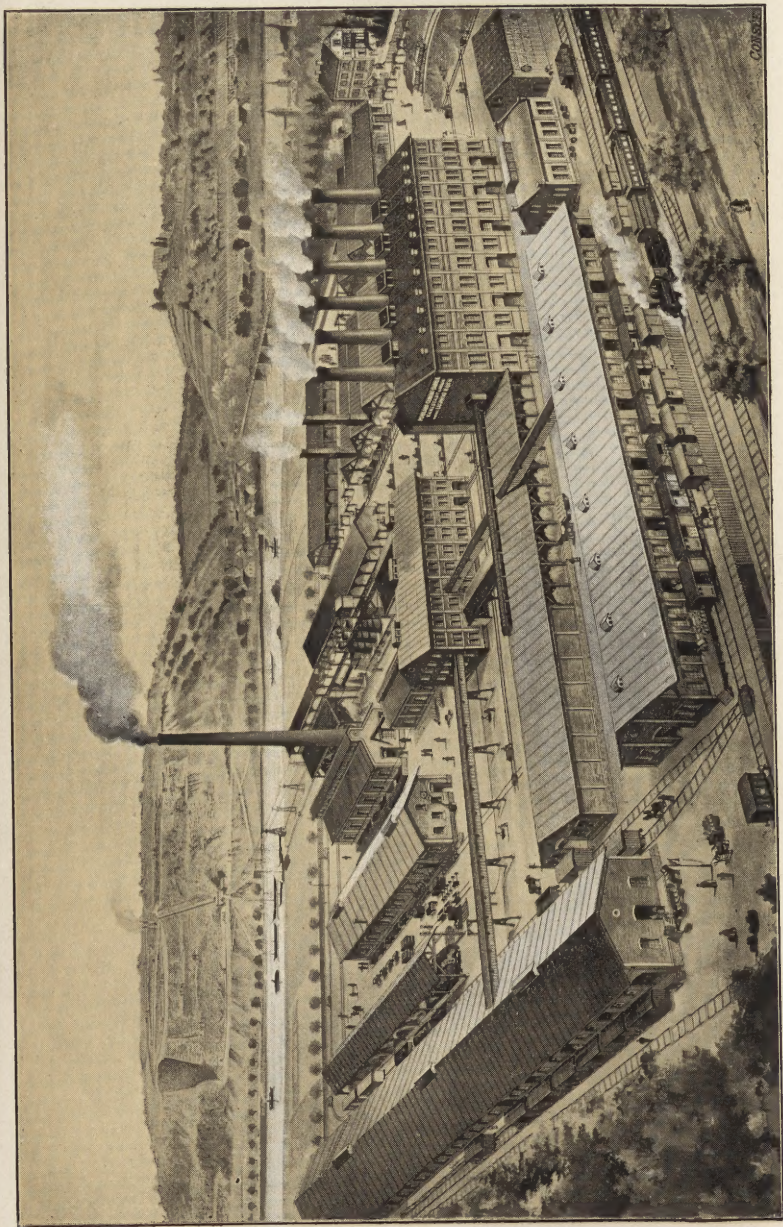
Morris Ebert.
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Maria Ebert.

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View of the Works.

PORTLAND-CEMENT-WORKS

KARLSTADT ON MAIN,

LATE LUDWIG ROTH.

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F. SCHEINER, WÜRZBURG.

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Gentlemen,

The rapid strides that the German Cement Export Trade has made during the last 10 years and the increasing popularity that these Cements enjoy has stimulated our Company to seek an enlargement of our Foreign connections.

Occupying a leading position in the Bavarian Cement Industry, we are now not only supplying the domestic local requirements but also selling largely to Southern Europe, the English Colonies and Eastern Countries.

With the object of showing to Consumers generally the process employed in manufacturing at our Works we made arrangements for a large exhibit at the Nuremberg Exhibition, at the same time making public exposition of the various tests to which our Cements are subjected and also other tests not generally in use and which we are sure

the scientific and practical requirements of up-to-date Cement Manufacturing will call for.

For a long time past it has been our special object to produce a Cement at our Karlstadt Cement Works (late Ludwig Roth) which would not merely comply with the tests called for by the regulations of the German Testing Station Charlottenburg, but at the same time fulfil more rigid tests, which, in accordance with more modern scientific manufacturing, are likely in time to supersede, or at any rate cause to be modified, the present regulation Government Tests.

With the object of bringing the above subject prominently before buyers and consumers we exhibited at the above Exhibition various new testing machinery and at the same time Diagrams and Tables illustrating the marked effect that outside influences have on the Cement testing. We are wishing specially to bring home to those practically interested in Cement consumption that just in the same way as Chemical Experiments, the temperature, the condition of the atmosphere and the special care in the preparation of the tests are items which tell with marked effect on the result. So, too, are results in Cement testing more or less influenced and governed by the same circumstances.

Believing that the result of our experiments

conducted at a considerable cost and with much care would prove of interest to Importers, Buyers and Consumers of Portland Cements in Foreign Markets, we have ventured to prepare this little Pamphlet and trust that it may be found of practical use and of general interest to those who, not possessing a complete testing machinery, will recognise the necessity of very careful examination of any Cement they are handling before either approving or condemning the results obtained.

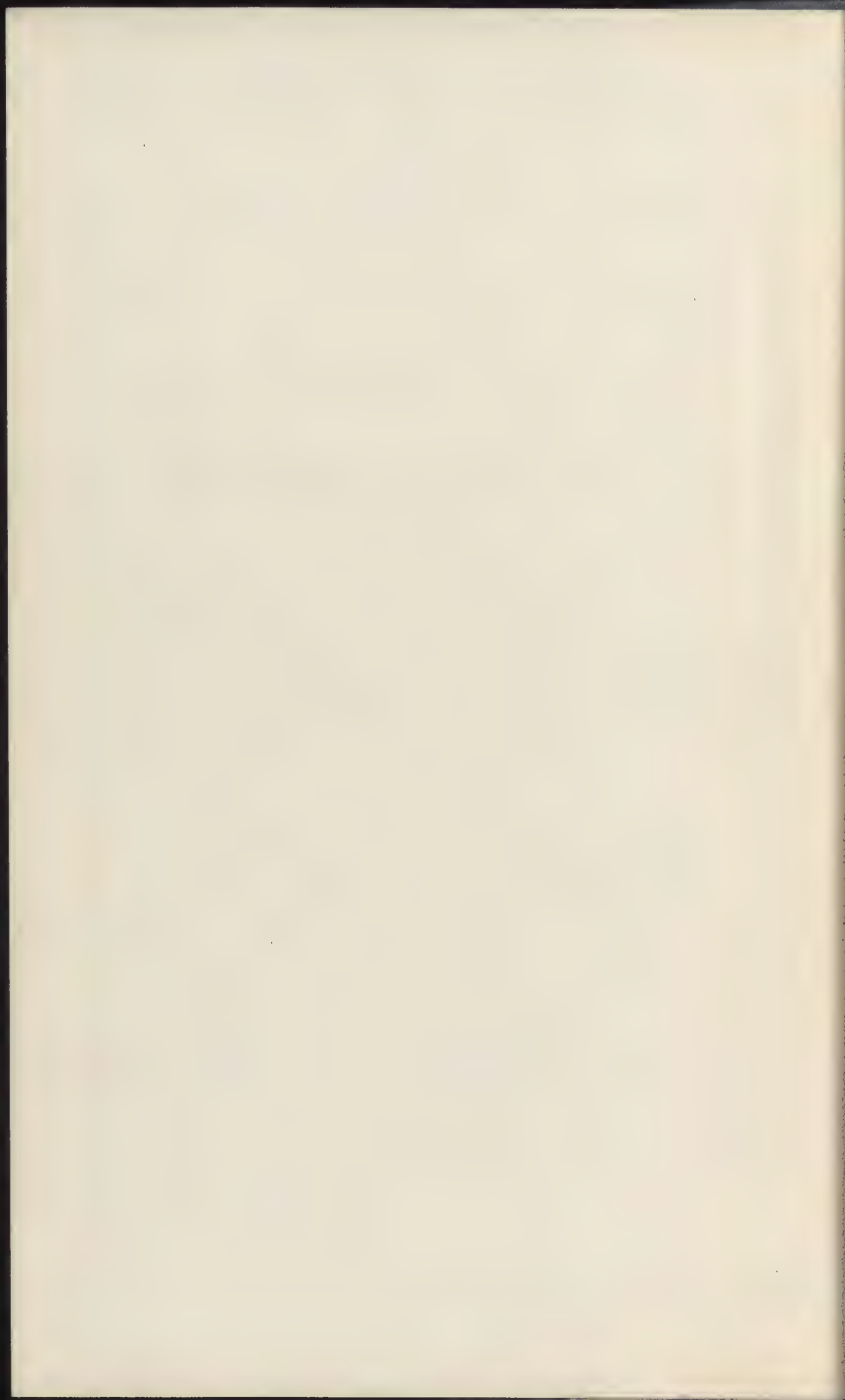
Recommending these remarks to your special attention and assuring you that we are always glad to give information and offer the best advice with regard to the important subject of Cement Testing,

We remain,

Yours faithfully,

The Karlstadt Portland Cement Works

(Late **Ludwig Roth**).



QUALITY TESTS.

A few practical hints on testing Portland Cement.

Generalities. With the object of ensuring uniform Delivery and tests of Portland Cement, the Association of German Portland Cement Makers established a certain standard for quality for all public work, this forming the basis for all Cement Tests. These Tests are employed to determine Fineness of Grinding, Uniformity of the Volume, Normal Time of Setting und Average Tensile Strength.

Although this standard is now universally adopted by the Manufacturers and accepted by the Consumers, it no longer meets the standpoint of practical Cement Manufacturing, it being found that there are a variety of circumstances which influence the tests and which had previously not sufficiently been taken into account when testing, thus oftentimes prejudicing the results. The Association of German Portland Cement Manufacturers have therefore decided to adopt a new standard embracing all the newest Testing Machinery, and thus replacing hand work, which is uncertain, by Machines and especially turning the attention more to the

observation of all outside influences on the Mortar. This new Standard will soon be submitted for the sanction of the Government.

The Testing Works exhibited by the Portland Cement Fabrik Karstadt on the Nuremberg Exhibition show all the newest machines for Mechanical and Scientific Tests.

Fineness of Grinding. The finer the grinding of the Cement the greater is its capacity for hardening, since any residue remaining after its passage through a sieve of 76×76 per sq. inch has not the same tensile strength.

It is a sine qua non in German Standard of Quality that a Portland Cement should show a fineness, to leave a residue of not less than 10 % after passing through a Sieve of 76×76 meshes. The higher class factories however supply a much finer product and this is an especial feature in the turn out of the Portland Cement Works, Karlstadt a/Main (Germany) which, in consequence of its efforts to produce the finest Cement, has brought its Machinery to the highest pitch of perfection for the purpose of producing a Portland Cement which should and actually does leave almost no residue on a Sieve of 76×76 meshes and in consequence of this superiority the Karlstadt Portland Cement permits the addition of a high percentage of sand, the hardening capacity being preserved to the fullest extent. In fact to test the fineness the Works employ Sieves of 180×180 meshes per sq. inch.

Consistency of Volume. According to the Standard Test it is required that a pat of Neat Cement prepared on a sheet of glass, protected against drying, and put under water for 24 hours, must not show any distortion or cracks at the corners and as these cracks appear within three days as a rule, a Portland Cement is to be considered uniform if it withstood this Test for 4 weeks.

This method, as used by Experts, works out very satisfactorily indeed and will be adhered to in future. But a wrong treatment of the Pats easily causes bad results and therefore is often the cause for unjustified Claims.

Very often for instance the Cement is put in too thin a layer on the glass sheet and exposed to the air and also to the sun without considering the exact formula of the Standard Tests. In consequence, the water evaporates too quickly and fissures or so-called shrinkage cracks are caused, whilst people often believe them to be blowing (swelling) cracks, caused by presence of free lime.

Even in a well closed room if the Briquettes are not carefully protected, which ought to be done by keeping them in a covered box or under wet rags, the result is often that a thin crust is formed on the surface of the briquettes in consequence of their drying out too quickly whilst the inner part remains soft for a long time. When the briquette is put in water later on, especially if this is done before the briquettes are quite hard, this crust separates from the pat, and these appearances often have led to the condemnation of the best Cement through the fault of the Tester guaging same.

It is still more easy for people, not thoroughly accustomed to scientifically testing Cement to prejudice results in such as the Boiling, Firing and Drying Tests, which of necessity require great care in the mixing of the Mortar and the determination of the amount of water to be employed.

For theoretical observations only the Testing Apparatus by Professor Bauschinger is used to measure any minima extension or shrinkage; this apparatus shows the variation in volume of a Briquette of say 4 inches long and 2 inches wide to a five thousandth part of an inch. Such an apparatus is exhibited by the Karlstadt Portland Cement Fabrik and is specially recommended to everybody who has any interest for it.

Setting. According to the rules a distinction is made between quick and slow setting Cements; the first named quality should be capable of Setting within two hours. To find out the exact setting time and to ascertain exactly the initial setting the Vicat Standard Needle is used. The moment the needle can no longer penetrate entirely a briquette of about 2 inches thickness, the Cement is said to have concluded its Initial Setting. The time however which elapses till the standard needle does not leave any more traces on the hardened cake, is the setting time.

At the Exhibition the Karlstadt Works have a very interesting Apparatus in use which automatically records the Setting in form of a diagram. This apparatus is constructed so that the standard

needle is moved on the Cement paste by clockwork and each time of penetrating the paste and the depth it goes to, is marked by a Bar on a slip of paper. Thus one can see from the diagram obtained automatically the exact time when the setting began, how it passed and when it has been completed without being obliged to follow up personally the Setting Process.

The ordinary system of testing the setting of Cement at the Building Work is done in a very simple way. All that is considered requisite is for a workman, at the place at which the Building is being carried on, to mix well for several minutes into a thick paste such a Quantity of Cement as will suffice for a slab of about half an inch thickness which should be placed on a glass plate or on a well burnt and well wetted brick. By testing this slab from time to time with the finger nail the period of setting can be accurately ascertained.

However simple this method is, it is not possible to control the effective Setting of the Cement nor to check the guaranteed setting time by the Works in this way, as the setting time is considerably influenced through the temperature of the air and the water used, in as much as high temperature accelerates, whilst low temperature delays it. Therefore in order to be accurate and in accordance with the standard system, tests ought only to be conducted in a medium temperature of water and air say 59 to 65°/o.

For the rest we refer to the diagrams and tables printed hereafter under the heading of „Influence of the temperature on Tensile Strength“

which will show the considerable influence that temperature has on the Setting of Portland Cement and how cautious one must be in forming a definite opinion.

Tensile Strength. The Tensile Strength of Portland Cement has according to the standard tests to be ascertained by testing a mixture of Cement and Sand. These Tests of tensile strength and pressure have to be conducted according to a uniform method by guaging briquettes of the same form and using the same Apparatus for breaking.

The tensile strength has to be tested by taking Briquettes measuring about 1 sq. inch of diameter at the place of fracture, whilst the pressure tests have to be conducted on cube briquettes of about 8 sq. inches surface. At the Exhibition such Tests are continually conducted in the presence of the Visitors.

To obtain a uniform result the standard tests demand a certain description of quartz sand which is known under the name of Standard Sand and can only be obtained from one place.

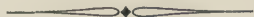
The German rules assume as decisive a test of strength after a hardening period of 28 days has elapsed and demand for slow-setting Cements formed of one part (in weight) of Cement to three parts (weight) of standard sand a minimum tensile strain of about 230 lbs and crushing resistance power of about 2300 lbs per sq. inch.

The actual standard Tests prove how necessary it is to have the briquettes made in an absolute

reliable and exact manner, yet the final results often show marked variation if special care is not given to the following points: ---

- 1) Difference in temperature.
- 2) Relative humidity of the air.
- 3) The Quantity of water that is used.
- 4) Description of sand.
- 5) The time the mortar has been mixed before making into briquettes.
- 6) The energy with which the mortar has been mixed.
- 7) The manner in which the Mortar has been pressed into the moulds.

We refer to the following tables and diagrams that will prove the marked influence that any divergence in above points has on final and actual results both in Setting and Tensile Strength.

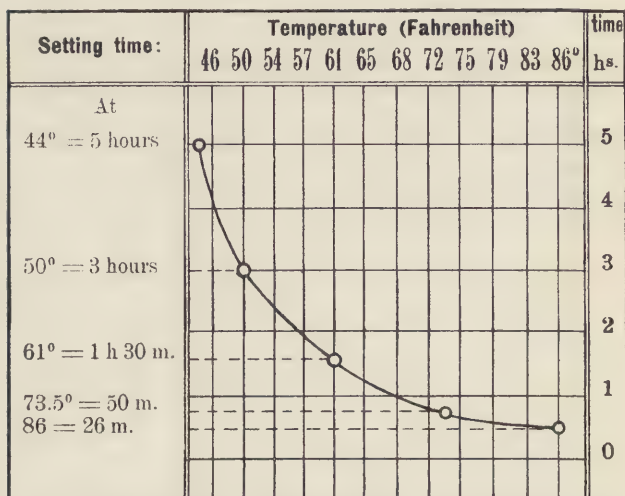


Influence of the Temperature.

A) on the Setting.

To ascertain the influence temperature has on the Setting, a Cement has been chosen, that will set in one hour and 30 minutes under normal conditions, viz. a temperature of the Cement, water and air of 61. F.

The Temperature of the air remaining the same viz. 61. F. the temperature of water and cement changing, the following results with regard to Setting time were found:



Thus a pat of Cement guaged at a temperature of 61. F. was slow setting, when the Cement and water had a temperature of only 44. F. (winter temperature) whilst it was of medium setting at 65. F. (normal temperature) and even quick setting at 86. F. (high summer temperature).

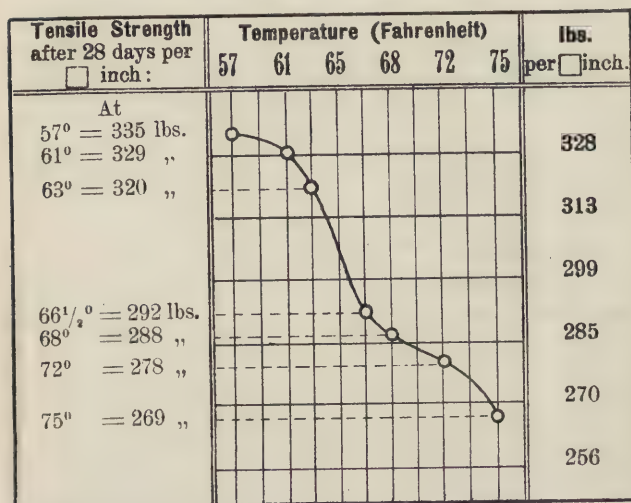
Influence of the Temperature.

B) on the Tensile Strength.

The Cement guaged showed a normal Tensile Strength of 329 lbs. per sq. inch after 28 days. (3 parts Sand 1 Cement).

Cement as well as sand and water have been reduced to the same temperature and the briquettes prepared under the same temperature in the room.

The results obtained were as follows:



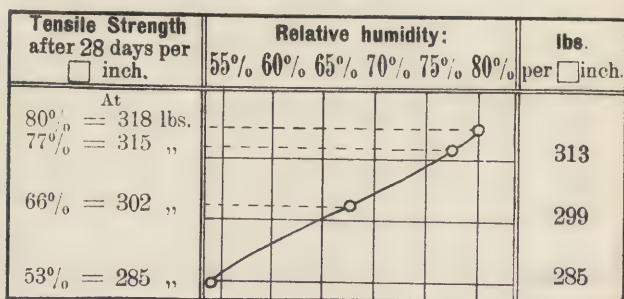
Thus with increasing temperature the Tensile Strength is reduced.

Relative Influence of Different Degrees of Humidity of the air.

The relative humidity of the Air is the proportion of saturation of (water) steam contained in the air compared with the Quantity of steam the air can possibly absorb and expressed in percentage accordingly.

The greater the relative humidity of the air, that is to say, the nearer the actual humidity contained approaches the quantity of Steam that the air can possibly contain, the more humid is the air, which is then less inclined to evaporate water.

The Cement absolutely requires humidity to harden and strengthen. If it is deprived of this humidity by dryness of air during the tests, the results will be prejudiced. It is possible to state the relative degree of humidity by means of the hygrometer and the following is the influence observed on results of Tests:

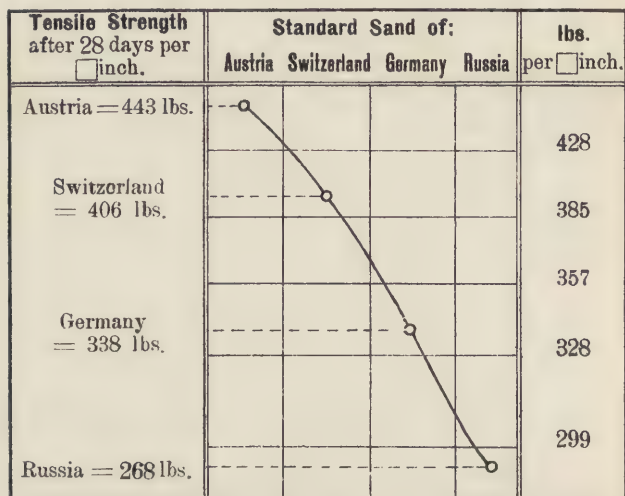


The more humid the air, the higher the tensile strength and this variation can show a difference which goes as far as 28.5 lbs per sq. inch.

The results obtained by different Standard Sands.

Although the various European States have adopted more or less the German Standard, the kinds of standard sands differ considerably. Thus the results of Tests obtained at the different Government Testing Stations differ considerably from each other.

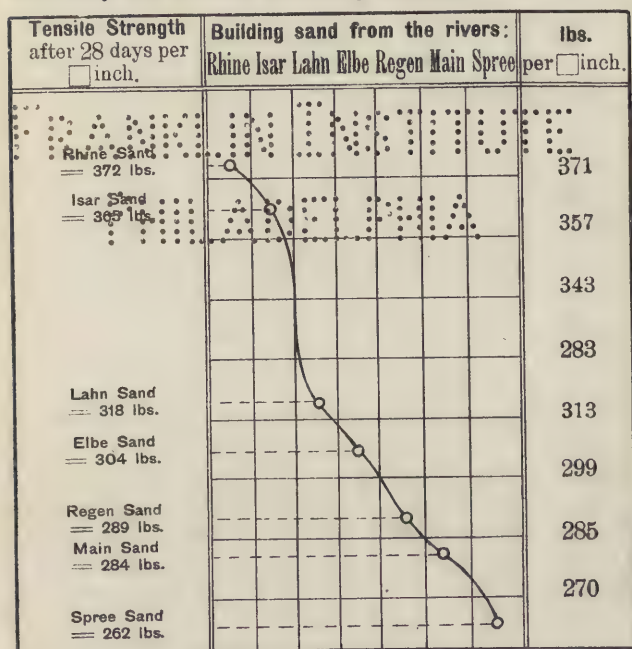
The following Table will show some differences:



Thus a Cement showing a Tensile Strength of 338 lbs when mixed with German Standard Sand showed only 268 lbs, when mixed with Russian Standard Sand, whilst it increased its strength to 443 lbs. with Austrian Sand, thus proving conclusively the influence of the sand on the Tensile Strength.

The results obtained by employing various kinds of Building Sand.

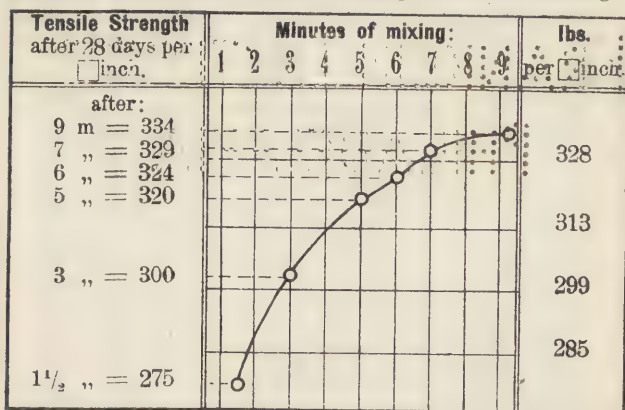
Very often sand that is going to be used for Building Work is also used for testing the Quality of the Cement after having been sieved and reduced to the size of standard sand. The results obtained in this way are very agreeable, but do not allow a proper judgement of the Quality of the Cement. How different the results of Tensile Strength are according to the various river sands existing in Germany shows the following diagram:



Thus the Cement mixed with Rhine Sand shows 372 lbs whilst the same Cement mixed with Spree Sand shows 262 lbs that is a difference of 110 lbs.

Time required to prepare the Mortar.

According to the Standard Tests the Mortar has to be mixed in a proper consistence in 5 minutes, when it is considered that the mixing is done continually during the 5 minutes and with the same energy all the time. Now in most cases this is not the case and is only done by very exact working testers who have the necessary technical training; thus most of the differences of the results of the tests are to be found in the manner in which the necessary mortar has been mixed. The following differences of Tensile Strength have been found after an absolute uniform mixing but with varying time of mixing:



It is thus shewn that until 5 minutes the increase in strength is a very considerable one, whilst above it is only quite a minimum increase, therefore it is necessary to work the mortar during 5 minutes uniform and well. Where it cannot be guaranteed that this preliminary work has been done in a thoroughly reliable manner, the results of tests obtained are without value.

Energy in mixing the Mortar.

As mentioned in the last paragraph the energy with which the Mortar has been mixed is of equal importance to the time (5 minutes) employed.

It is evident that to work the Mortar during five minutes without energy and with interruption is of no more value than continual mixing of one minute. On the other hand, thorough mixing of one minute only is not sufficient as until five minutes are reached the Tensile Strength steadily increases.

Therefore the results of Tests are to a great deal dependent upon the reliability and experience of the person that conducts same and it is therefore wisely suggested to replace this plan that causes so many bad results, by employing Machines in the same way as has been done for the pressing of the Mortar into the Moulds.

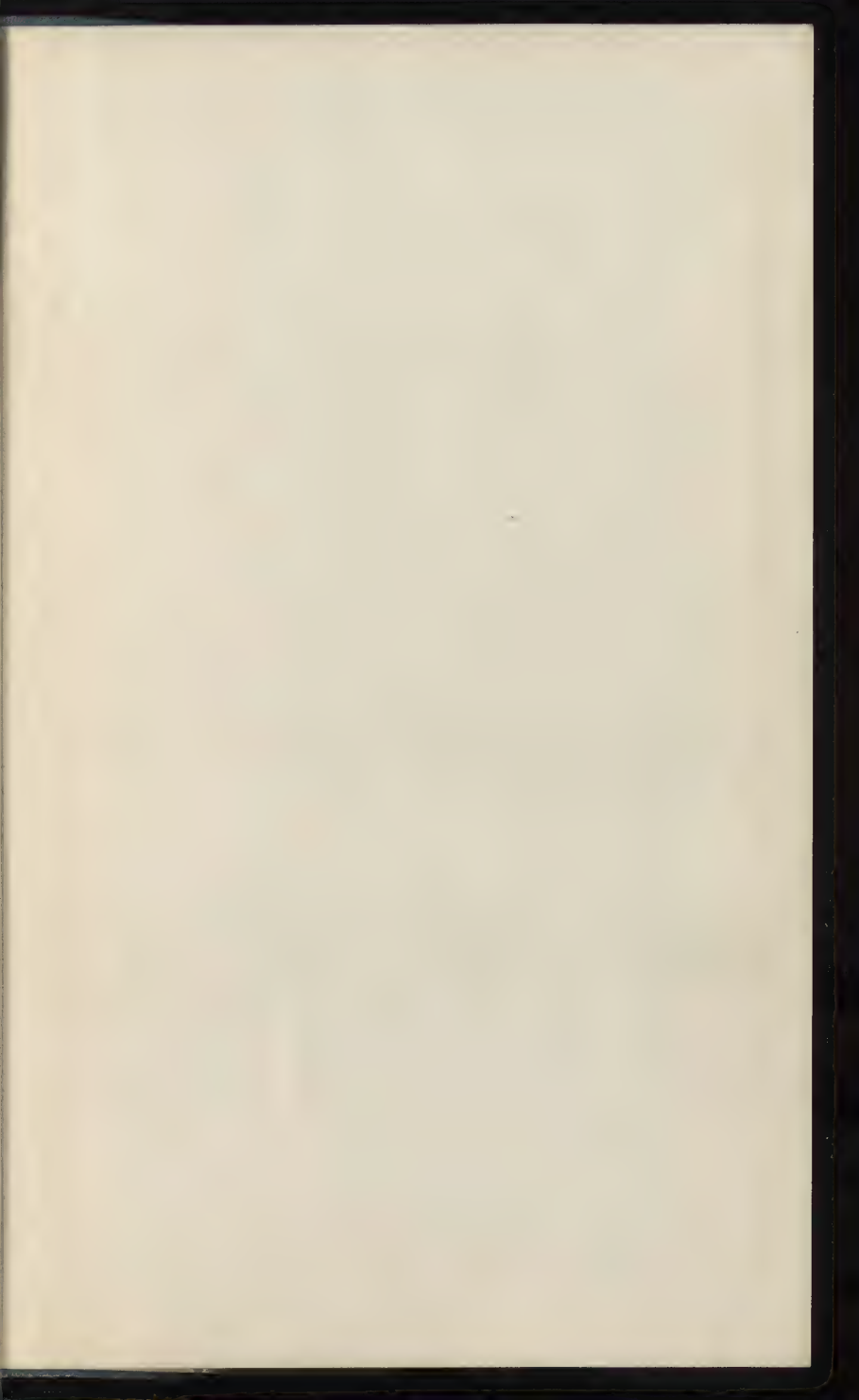
At the Nuremburg Exhibition there is a Mortar Mixing Machine in use, the speed of which is exactly uniform and thus always shows uniform results independent of hand labor.

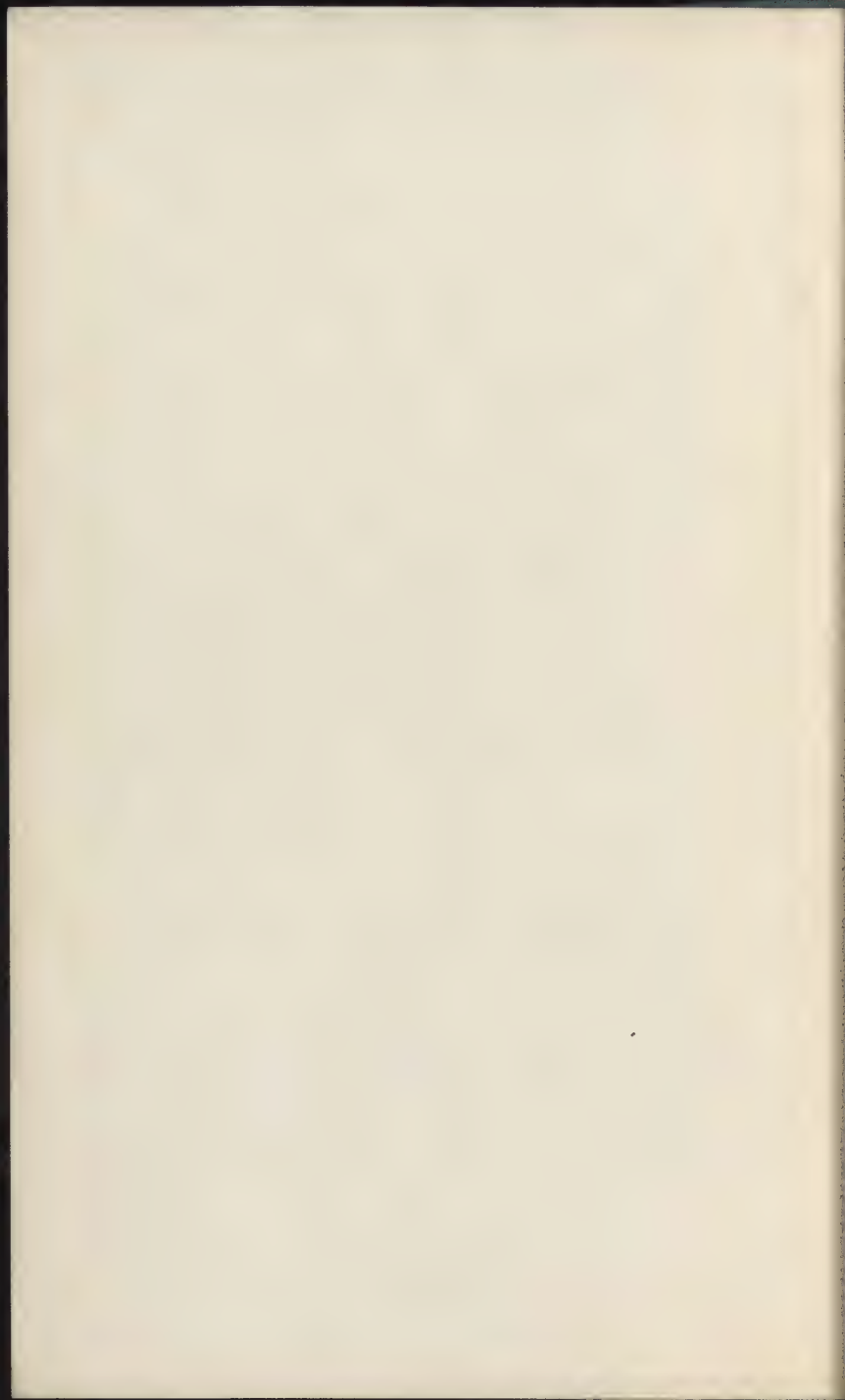
The pressing of the Mortar in the Moulds.

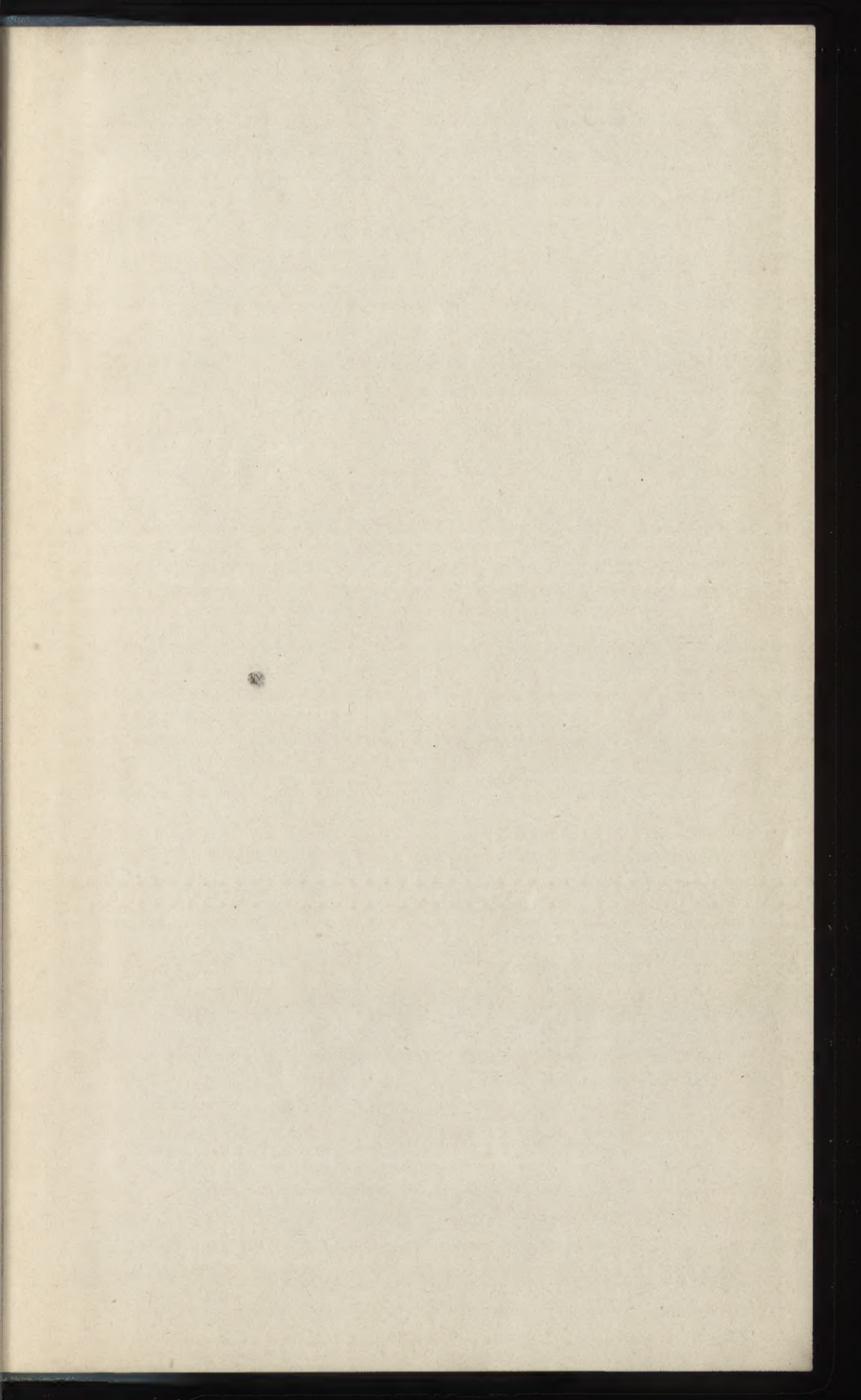
Just in the same way as the careless mixing of the Mortar is the reason for bad results thus inducing all kinds of unjust Claims, the manner in which the Mortar has been pressed in the Moulds is in the same way responsible. The standard tests recommend the Böhme Hammer Apparatus for this purpose and in fact for official tests this apparatus is exclusively in use. The Briquettes at the Exhibition are pressed in the Moulds in this way, but apart from this apparatus we exhibited the Klebe Apparatus for the same purpose.

Final remarks.

Above actual experiments will bear out how carefully and scientifically Tests have to be conducted to obviate varying results of Tests and oftentimes consequent wrong conclusions with regard to the Quality of the Cement, although it often appears that the standard tests had been followed exactly. Even where the greatest care of the mechanical part of test is to be depended on, there are so many points that influence the Results, viz. temperature, humidity of the air, water etc etc, that differences in the results are bound to happen where proper and complete Laboratories provided with all Apparatus and Instruments are not at the disposal of those testing. As this however is only very seldom the case, the conducting of Tests ought to be left entirely to Official Testing Stations provided with all the necessary Apparatus and Machinery.







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